R E P O R T R E S U M E S

ED 011 952 24 AA 000 071

WORDS VS. PSEUDO WORDS. STUDIES OF ORAL READING, I.

BY- LEVIN, HARRY BIEMILLER, ANDREW J.

REPORT NUMBER BR-5-0617-5 PUB DATE 65

CONTRACT OEC-4-10-113

EDRS PRICE MF-$0.09 HC-$0.84 21P.

DESCRIPTORS- *RESPONSE MODE, *READING RESEARCH, READING ABILITY, STIMULUS BEHAVIOR, BEHAVIOR RATING SCALES, *REACTIVE BEHAVIOR, GRADE 2, GRADE 3, GRADE 4, *MEASUREMENT TECHNIQUES, *ORAL READING, ITHACA

THIS STUDY WAS DESIGNED TO TEST THE VALIDITY OF RESPONSE LATENCY AS A BEHAVIORAL INDEX TO READING. CHILDREN IN GRADES 2, 3, AND 4 WERE SHOWN A RANDOMIZED LIST OF 16 WORDS CONSISTING OF EIGHT REAL WORDS AND EIGHT PSEUDOWORDS. THE TIME THEY TOOK TO GIVE A VERBAL RESPONSE TO THE WORD AFTER ITS EXPOSURE WAS MEASURED. THE RESULTS SHOWED THAT CHILDREN ARE HIGHLY CONSISTENT IN THEIR BEHAVIOR ACROSS TRIALS AND BETWEEN THE TWO TYPES OF WORDS WITHIN TRIALS. YOUNGER CHILDREN TOOK LONGER TO READ REAL WORDS THAN OLDER CHILDREN, LATENCIES DECREASED OVER TRIALS, AND IT TOOK LONGER TO READ PSEUDOWORDS THAN REAL WORDS. WHILE MORE ERRORS WERE MADE IN READING PSEUDOWORDS RATHER THAN REAL WORDS, YOUNGER CHILDREN MADE MORE ERRORS THAN DID OLDER ONES. WHEN FREQUENCY OF ERRORS WAS CONTROLLED, THERE WERE NO DIFFERENCES IN THE LATENCIES OF REAL AND NONSENSE WORDS READ INCORRECTLY, BUT FOR CORRECT RESPONSES, REAL WORDS WERE READ MORE QUICKLY. THESE FINDINGS INDICATE THE USEFULNESS OF RESPONSE LATENCY AS A MEASURE OF READING. (GD)

AA000071

BR-5-0617-D
OEC-4-10-113
P.A. 24

Studies of Oral Reading[1]

I. Words vs. Pseudo Words

Harry Levin and Andrew J. Biemiller[2]

Cornell University

This study is the first of a series on oral reading. The experiments will share a common empirical model and a common analysis of the sub-skills which comprise the complex process which is reading. The independent variables will be variations of the stimulus materials: words, pseudo words, phrases, sentences, and the like. The dependent response variable will be latency: the period of time between the presentation of the graphic stimulus, and the onset of the subject's verbal response, reading the word or words aloud. In the present study, we also examined the effects of the experimental variations on reading errors, and the relationships between errors in reading and response latency.

For analytic purposes, we think that reading involves two sub-processes which, at least during the period when the skill is unformed, take place in sequence. The first is <u>decoding</u> in which the reader converts written material into associated language. The second process is <u>code use</u> during which the reader converts the decoded writing into information, guides to actions, etc. Our purpose in the present study has been to establish response latency as a valid index to the process of decoding. We chose, therefore, stimulus materials which, on <u>a priori</u> grounds, represented two

1. This study was supported by funds from the Cooperative Research Program, U.S. Office of Education.

2. We wish to thank Miss Susan Bostwick for her help with this study.

ED011952

extreme degrees of difficulty. In addition, the ages of the subjects were chosen to represent various degrees of skill in reading. We reasoned that if latency was responsive to the variations in stimuli and in subjects, we could be confident in its use as a dependent variable in subsequent studies.

When we originally conceived the present study, it seemed reasonable to expect that words which a child had encountered frequently, either in print or aurally, would be decoded and responded to more rapidly than words which a child had never before encountered. We operationalised this notion by constructing two sets of words, eight "real" words and eight "pseudo" words (e.g., BLERM) and presenting them to second, third, and fourth graders to read aloud.

The validity of response latency as an index of decoding difficulty would be sustained by the following results:

1. Shorter response latencies to real words than to pseudo words.
2. Shorter response latencies associated with higher grade levels in school.
3. Shorter response latencies during the second trial compared to the first.

METHOD

Stimulus materials. The words used appear in Appendix A. The word list was generated as follows:

a. Four initial spelling patterns were selected: BL, CH, GR, ST.

b. Four final spelling patterns were selected: CK, ND, RM, SS.

c. Each initial pattern was combined with each final pattern.

d. By manipulating the vowel letters a snd e, two real and two pseudo

words were generated for each initial and each final spelling pattern. All words had five letters.

e. Where possible, two words with e and two with a were provided for each spelling pattern. This was not always possible. The vowel o was used in storm as the only possible word meeting criterion (d) above. The word bland was treated as a pseudo-word on the assumption that it would be unfamiliar to most of our sample. We now think this was an error. Three additional words were used as "warm-up" words.

Subjects. We tested 54 children from the West Hill Elementary School[3] in Ithaca, N.Y.. This school serves a population with a wide variation in economic levels. Eighteen children each were drawn from the second, third, and fourth grades. Half of each group of eighteen were boys and half girls. These subgroups were chosen according to "reading ability" by drawing three boys and three girls from the "best" reading group in a class, three, from the "worst who can read" and three, from a group "in between." (We have not reported data for this ability grouping because we do not feel that the assessment is reliable).

Procedure. Each child was informed that "we are getting recordings of how children talk. I'm going to show you a lot of words on the screen and I want you to tell me what they are. We made up some of the words, so you needn't feel badly if you don't know them."

A lapel microphone was attached and the words projected on a screen three feet from the subject. The projected words were about six inches

3. We are grateful to the staff of the school for their cooperation.

long by two inches high. After the child responded to a word, there was a two second interval before presenting the next word. If the child made no response to a word in fifteen seconds, he was asked, "Would you like to go on to the next one?" (He invariably did.) Similarly, if the child suggested going on, the next word was displayed.

RESULTS

The subject's responses were tape recorded. The tapes were then played through a rectifier which was connected to a pen-writing Brush recorder. This system activates the pen when sound is present and the pen comes to rest during silence. A characteristic sound made by the projector served as a marker indicating the presentation of the stimulus. Latency was measured from this point to the onset of the last word the child gives as a response to that stimulus. All false starts, vocal segregates, etc., are treated as part of the response latency. Omissions were arbitrarily scored as a 12.5 second latency. (We observed that the maximum latency followed by a response was twelve seconds.)

The data were transformed according to the following formula: $x = \log(2.5y - 1)$, where x = transformed score; y = response latency in seconds. This transformation is discussed in Woodworth and Schlosberg (1954, p 39).

The transcription of all tapes was used to make a qualitative analysis of the reading errors. The results of this analysis appear in Appendix B to this paper.

The reliabilities of individual children's response latencies are given in Table 1. Each S read the list twice. The list orders were the same for all children. Subjects were quite consistent from trial to trial, although, as will be seen shortly, the mean latencies decreased over trials.

Another measure of consistency is the relationships between the latencies to real and pseudo words, within trials. As can be seen in Table 1, children are consistent in reaction times to these two types of words, in spite of the fact that their latency for real words is shorter than their latency for pseudo words.

Table 1

Correlations Between Individual's Scores
On First Trial vs Second Trial

	Grades			
	2nd	3rd	4th	Combined
First Trial x Second Trial (all words)	.87	.62	.81	.86
Real Words x Pseudo Words:				
First Trial	.74	.68	.68	.83
Second Trial	.99	.70	.62	.82

The main results of the study are summarized in Table 2. An analysis of variance was calculated on these data, with the classifications, real vs. pseudo-words, grade levels, and trials. The results of this analysis are:

1. Children show longer latencies in reading pseudo words than real words ($F = 70.96$, $df = 1, 51$; $p < .01$).
2. Latencies are longer on the first than on the second trial ($F = 28.83$, $df = 1, 51$; $p < .01$).
3. Younger children evidence longer latencies than older children ($F = 10.56$, $df = 2, 51$; $p < .01$). This finding is qualified by an interaction between grade levels and word type ($F = 8.59$, $df = 2, 51$; $p < .01$). Perusal of the means in Table 2 indicates that second graders show a small difference between real and

pseudo-words, whereas for the third and fourth grades the mean latency for pseudo-words is substantially longer than for real words.

Table 2

Average Response Latencies (in seconds)

	Grades			
	2nd	3rd	4th	Combined
All words	4.51	2.66	2.43	3.20
Real Words	4.10	1.85	1.55	2.50
Pseudo Words	4.86	3.48	3.31	3.90
First Trial	4.74	2.96	2.64	3.45
Second Trail	4.27	2.36	2.22	2.95

Errors in Reading. From the tapes, we judged whether or not the word was read correctly. Of the total of 1728 responses, 1035, or 60% were read correctly. Further, 42% of the pseudo-words and 78% of the real words were correct. In this section, we shall examine the determinants of frequency of errors and the latencies in reading words correctly and incorrectly.

The mean number of errors per subject are given in Table 3. An analysis of variance according to type of word, grade levels and trials yielded two significant main effects and no significant interactions. There are more errors in reading pseudo-words ($F = 104.5$, $df = 1, 51$; $p<.01$) and in the second compared to the third and fourth grades ($F = 7.3$, $df = 2, 51$; $p<.01$).

In addition to the frequency of errors, we investigated the latencies in reading words correctly or incorrectly. The mean latency for correctly read words is 2.08 seconds and for incorrectly read ones, 4.85 seconds. The difference between these means is statistically significant ($t = 64.29$,

181 df, p<.005).

Table 3

Average Number of Errors

	Grades			
	2nd	3rd	4th	Combined
All Words	4.6	2.5	2.2	3.1
Real Words	3.4	1.0	0.7	1.7
Pseudo Words	5.7	3.9	3.7	4.4
First Trial	4.6	2.5	2.4	3.2
Second Trial	4.5	2.3	2.1	3.0

The first unadorned analysis indicated that reactions were more rapid to real words than to nonsense ones and that younger children responded more slowly, in general. The subsequent analysis of whether the reading was correct force us to make serious qualifications to the original findings. Pseudo-words are more frequently read incorrectly and younger children make more errors. The latencies are longer to errors than to correct read words. Are the first findings, then, due simply to the differences in frequency of errors? Two subsequent analyses clarify this issue. The latencies for each child were divided into correct and incorrect readings and within this control, the mean latencies to real and pseudo-words were inspected. The results are given in Table 4. Interestingly, the real-pseudo difference holds up only for correctly read words. If the child makes an error, his response is roughly equally slow for both types of words.

Again using the correctness of reading as a control, we inspected age differences in latencies. The initial finding generally holds: older children read words more quickly than younger ones.

Table 4

Average Response Latencies (in seconds) for Words Read Correctly and Words Red Incorrectly.

	Grades			
	2nd	3rd	4th	Combined
All Words:				
Correct	2.66	2.14	1.67	2.08
Incorrect	5.88	3.41	4.62	4.83
Real Words:				
Correct	2.54	1.61	1.24	1.69
Incorrect	5.97	3.82	4.40	5.32
Pseudo Words:				
Correct	2.91	3.25	2.42	2.82
Incorrect	5.83	3.91	4.66	4.68
First Trial:				
Correct	2.80	2.34	1.72	2.21
Incorrect	6.09	4.30	4.87	5.27
Second Trial:				
Correct	2.49	1.94	1.63	1.95
Incorrect	5.67	3.47	4.34	4.71

DISCUSSION

Reading is a private process. The principle barriers to research on the process of reading are the lacks of clear external indices to the process. Eye-movements are one such index, but the measurement of eye movements are extremely complex and fraught with difficulties of interpretation. Frequently, reading is studied by tests of speed of reading or comprehension of what has been read. For our purposes, these measures confound the decoding and information processing subskills. We decided, therefore, to take oral reading as an index which will be common to a series of experiments. The process will be inferred from the ways in which the common index varies with systematic variations in the stimulus materials. Taking such an external manifestation of reading leaves us vulnerable to the

contention that reading aloud and silently involves different skills, basically. We doubt that this is true, although a firm answer must itself wait on research which compares the two modes of reading. McLatchy's 1949 study of second graders shows a high association between scores on oral and silent reading tests. (Edfeldt, 1960; Flavell, 1965). We might point out, also, that developmentally, oral precedes silent reading and it is a common observation that when the materials being read are difficult, there is a tendency to mouth or to say the words.

This study was designed to test the validity of response latency as a behavioral index to reading. As such we chose stimulus materials and an age range which should maximize differences among groups. If the index were not sensitive to these extreme variations it would be useless although we do not yet know its potential value in detecting more subtle variations. In general, the results indicate the merit of latency for future research.

Although our strategy was empirical, the results, even at this early stage of research, tempt us to theorize about the process of decoding written words to their language equivalents. One tactic of the reader, and a highly unlikely one, is that the reader starts at the left of the word and sounds out the letters or groups of letters serially. If it happened, this would be a pure instance of decoding from spelling to sound. There is ample evidence that reading does not work this way. In our data, such a decoding process would not yield the differences in latency or errors between real and pseudo-words. Also, we observed that when our subjects read the words aloud, they usually read smoothly with the sounds blended together, even when the response was an error.

Our theory must account for these findings: (1) correct real words

are read more quickly than correctly read nonsense materials, and (2) incorrectly read real and nonsense words take equally long. As a first approximation to a theory we hypothesize that speakers of a language store in memory auditory representations of the sounds of their language, English in our case. We say, for example, that a snatch of language we hear and which we do not understand "sounds like English." When the word is exposed to the child he rehearses it. He matches the consequences of this rehearsal to his auditory memory and emits it with varying latencies and correctness, depending on a number of factors.

If he decodes to a familiar group of sounds, there is a close match between his response and his memory and the word is emitted. Correctly read real words are emitted rapidly (an average of 1.69 seconds). The pseudo-words in this experiment were designed to abide by English spelling patterns so that their correct rehearsal would yield English-like sounds (the latencies to these words average 2.14 seconds.) It is tempting to think that the real words are read rapidly because they are familiar to the child or because in their decoding the child makes a judgment about their meaning. While these steps may take place, we prefer the more general formulation of a dimension of familiar sounds in which familiar, previously heard words anchor the dimension at one end.

In the light of this reasoning, consider the relationships between errors and real and pseudo words. Decoding errors, in both cases, move the result toward the unfamiliar end of the sound dimension. The children's equal and long latencies for both categories probably reflect their perplexity with the outcome of the decoding. It may be that the subjects rehearse the sounds, checking to see whether they can bring the sounds into

line with their auditory memories. Whether or not the words "look" familiar has little effect, since decoding errors lead to roughly equal latencies for both types of words.

The responses to the word bland are instructive. From our pretest experiences we put the word into the pseudo category because none of the children knew what it meant. Nevertheless, in this study, the mean latency in reading bland was the shortest of all the pseudo words and briefer than some of the meaningful words. The word is made up of some common English sound elements--lənd, and--so that decoding yielded a familiar sound pattern, but not a familiar word.

If our reasoning is correct, errors in reading which eventuated in real words should have briefer latencies than errors which were finally read as nonsense forms. Such was actually the case. The mean subject latency for errors read as real words was 2.9 seconds, while for errors read as pseudo words it was 4.0 seconds. This effect is clear both on real words and pseudo words. Sign tests of this difference are significant at the .001 level for errors on real words and the .005 level for errors on pseudo words.* These findings imply that when the rehearsal and matching process yields words, the process is terminated more rapidly than when the consequence is unfamiliar to the child.

The process leading to the word read aloud, as we see it now, goes something like this. The child decodes the word into an auditory equivalent (forms an "auditory image"). He checks this image against his auditory memory of words he knows or sound patterns that he is familiar with. The

* The sign tests were run only on subjects with both types of errors. The mean subject latencies for real word type errors only was 2.2 seconds (n=12) and for pseudo word type errors only was 2.6 seconds. (n-9).

closer the match, the more quickly he says the word. Unfamiliar sound patterns may increase latency by leading to further decoding, rehearsal, matching, or confusion. What are the implications for the age differences in decoding that we have found? We doubt that there is much difference in the familiarity with words or the English sound patterns between seven and nine year olds. Their ability to decode the writing into corresponding sounds, though, is probably vastly different. We find, therefore, more errors at the younger age levels and especially long latencies for errors (unfamiliar sound patterns) by the second graders.

We emphasize that our formulation is tentative and subject to change as we accumulate more data. Several directions are visible, however. The next study systematically varies familiarity of sound patterns by presenting words differing in pronouncibility (Underwood and Schultz, 1960). Another idea is to confuse the auditory matching phase by feeding in sound during the exposure-response interval. If possible, we should like to use a list, in another study, in which the spelling to sound correspondences are simple but the resulting sound patterns are unfamiliar. Finally, we would expect more signs of rehearsal such as lip movements, EMG recordings from the larynx, and practice vocalizations (Flavell, 1965) during instances of unfamiliar words.

This formulation of the process of decoding and reading aloud may be summarized by an analogy to playing the piano. Some scales are more difficult to play than others. The mastery of the scales come from mastering the correspondences between written notes and finger movements. Likewise errors are recognizable by their degree of dissonance from a practised and anticipated musical sound pattern.

SUMMARY

This study was designed to test the usefulness of latency in reading words aloud as a response index to the process of reading. Children in the second, third, and fourth grades were shown a randomized list of sixteen words -- eight real and eight pseudo-words. The time they took to give a verbal response to the word after its exposure was measured. The results were as follows:

1. Children are highly consistent in their behavior across trials and between the two types of words within trials.
2. Younger children took longer to read the words than older children.
3. Latencies decrease over trials.
4. It takes longer to read pseudo-words than real words.
5. More errors in reading are made to pseudo than to real words.
6. Younger children make more errors than do older ones.
7. Latencies are longer to words read incorrectly than to ones read correctly.
8. When frequency of errors are controlled, there were no differences in the latencies of real and nonsense words read incorrectly, but for correct responses, real words were read more quickly.

These findings indicate the usefulness of response latency as a measure of reading. The results were interpreted tentatively according to a formulation which analyzes oral reading into the processes of decoding and matching to auditory memory.

APPENDIX A

Latency Means, Latency Standard Deviations, and Percentage of Errors-Both Trials Combined

	Real Words								Pseudo Words							
	Black	Stand	Grand	Bless	Grass	Storm	Check	Charm	Bland	Steck	Chass	Grack	Grerm	Chend	Blerm	Stess
All mean latency	1.51	2.09	2.32	2.75	2.76	2.78	3.05	4.11	2.78	3.72	4.13	4.14	4.25	4.64	4.88	5.39
s.d.	1.39	2.19	2.20	2.73	2.72	3.50	4.10	3.98	3.01	3.13	3.60	3.56	3.42	3.75	4.13	3.98
Percent Errors	9	9	24	31	20	15	35	27	37	63	63	52	93	44	53	62
4th grade																
mean latency	.92	1.00	1.67	1.80	1.91	.92	2.08	3.05	1.26	3.60	4.44	3.32	3.73	3.46	3.72	5.36
s.d.	.25	.35	2.61	1.42	1.61	.35	3.61	3.84	.56	3.83	4.42	4.52	4.65	3.40	3.71	4.71
Percent errors	0	6	16	14	5	3	11	11	34	36	41	52	66	36	47	41
3rd grade																
mean latency	1.12	1.74	1.46	2.46	1.88	2.64	2.36	2.55	2.70	3.17	3.17	3.33	4.14	4.88	4.60	5.09
s.d.	.39	1.41	1.12	2.60	1.11	2.86	3.52	2.67	3.28	2.00	2.49	2.88	3.28	3.86	3.69	3.85
Percent errors	3	6	11	25	11	8	30	11	39	69	66	52	94	36	47	61
2nd grade																
mean latency	2.48	3.52	3.84	4.00	4.50	4.77	4.70	6.74	4.39	4.40	4.79	5.77	4.88	5.58	6.31	5.78
s.d.	2.06	2.92	3.55	3.45	3.69	4.65	4.74	4.05	3.59	3.15	3.65	4.00	3.56	3.86	3.74	3.50
Percent errors	25	16	44	10	44	34	64	58	39	86	83	52	100	61	66	77

APPENDIX B

Analyses of Errors.*

We have classified errors two ways. The first classification is concerned with errors read as real words versus errors read as pseudo words. The second classification is concerned with the part of the word where an error is made.

Table 6 suggests that neither grade nor real vs. pseudo type words affect the proportion of errors given as real or pseudo (with the possible exception of the third grade's response to real words).

Table 6

Classification of Errors

	Real Words Grade				Pseudo Words Grade			
	2nd	3rd	4th	Combined	2nd	3rd	4th	Combined
Number of Errors	126	38	26	190	204	168	133	505
Percent read as real word:	50	37	48	47	47	50	50	49
Percent read as pseudo word:	38	55	38	42	42	37	36	40
Percent omitted:	12	8	15	11	11	13	14	11

Tables 7 and 8 suggest that the determinants of whether word errors are real, pseudo, or omitted have a lot to do with the word in question. In Table 7, the frequency of occurrence in the Thorndike-Lorge Juvenile list is inversely associated with the number of errors and number of

---

* We wish to thank Miss Susan Bostwick for her help in preparing this section.

Table 7

Classification of Errors - By Real Words

	Frequency occurrences Per million words*	Number Errors	Number real	Number pseudo	Number omitted
Bless	44.5	34	12	19	3
Charm	58.5	29	3	17	9
Grand	80.6	26	9	12	5
Check	92.8	38	16	11	11
Storm	122.0	5	7	5	
Grass	155.5	22	12	6	4
Black	220+	10	6	4	0
Stand	220+	10	6	3	1
Total		186	69	79	38

*Adapted from Thorndike and Lorge, 1944.

Table 8

Classification of Errors - By Pseudo Words

	# errors	# real	# pseudo	# omitted
Steck	69	50	5	14
Chass	69	46	10	13
Grerm	101	38	56	7
Bland	40	35	5	0
Grack	57	32	17	8
Cherd	48	19	20	9
Stess	65	16	33	16
Blerm	58	11	32	15
Total	507	247	178	82

pseudo-type errors. It is less clearly associated with omissions and real-type errors.

In Table 8, a case could be made for a relationship between the number of real-type errors and the number of letter changes needed to change the pseudo word to a real word. Inspection of the transcript sheds some doubt on this hypothesis.

Our second classification of errors involves breaking words down into three parts: initial (first letters); medial (next three letters); and final (last letter). A word can be categorized as correct (c) or incorrect (i) in any of these three parts. Thus, if the word BLACK were read "BLECK", it would be classified cic. These errors are summarized in Table 9.

Table 9

Errors by Part of Word

	Real Words					Pseudo Words				
		percent					percent			
	#	2nd	3rd	4th	Com	#	2nd	3rd	4th	Com
icc, ici, & iii	21	17.5	5.3	7.7	11.0	67	20.1	17.9	10.5	13.2
cic	34	18.3	13.2	23.1	17.9	125	18.6	26.2	32.8	24.8
cic (vowel only)	22	8.7	15.8	19.3	11.6	85	12.7	23.2	14.9	16.8
cci	5				2.6	21				4.2
iic	14	5.6	15.8	3.9	7.4	45	11.3	5.9	9.0	8.9
cii	72	38.1	42.1	30.4	37.9	110	30.4	13.7	18.7	21.8
omissions	22	11.9	7.9	15.4	11.6	53	11.0	13.1	14.2	10.5
total	190									

A qualitative analysis of the errors themselves may be seen in Table 9. The highest difference between the real and pseudo groups is in the proportion of errors made with the initial consonant. The Pseudo group of words has twice as many of this type of error proportionally than the real

group. With this exception and that of the cii group which accounts for 39% of the real group errors and only 22% of the pseudo group errors, there is little difference between the types of errors made on both groups of words.

When the error types are examined by grade level (See Table 3) the following major differences may be noted: 1. That medial errors account for almost 50% of the errors for both the real and pseudo groups and when the medial error is combined with the terminal error the two account for almost two-thirds of all the errors for both groups. 2. With the exception of the 2nd Grade which remains constant, the proportion of cii errors in the real group is almost twice that of the Pseudo group. 3. The 3rd Graders show in almost every case the greatest amount of fluctuation in specific errors types employed. That is, they appear to have two distinct approaches, one for 'real' words and one for 'pseudo' words.

References

1. Edfeldt, A. W., Silent speech and silent reading. Chicago: Univer. Chicago Press. 1960.

2. Flavell, J. H. The function of private speech in children's thinking.. Paper read at Society for Research in Child Development Meeting, Minneapolis, March, 1965.

3. McLatchy, J. H. An oral-reading test as an appraisal of progress. Educ. Res. Bull. (Ohio State Univ.), 1949, 28, 230-239.

4. Thorndike, E. L., Lorge, I., The Teacher's Word Book of 30,000 Words. Bureau of Publications, Teacher's College, Columbia Univer., New York, N.Y., 1944.

5. Woodworth, R. W., & Schbsberg, H., Experimental Psychology, Henry Holt and Company, New York, 1954.